**U.S. Department of the Interior
National Park Service**

**Monitoring Brown Bears in
Southwest Alaska Network National Parks**

DRAFT Protocol Narrative

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Revision History Log:

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This protocol narrative, along with 7 associated Standard Operating Procedures (SOPs), provides detailed information on monitoring brown bears (*Ursus arctos*) in Southwest Alaska Network National Parks. The protocol narrative provides a general overview of the history, justification, sampling methods and procedures of performing monitoring operations. The SOPs provide specific, step-by-step instructions for performing the various monitoring tasks and are more detailed in nature than the protocol narrative. Both documents were created for use together as a unit.

I. Background and objectives

1.1 *Background and history*

The purpose of this document is to detail the protocol used to monitor brown bears in four National Park Service (NPS) units in southwest Alaska, namely;

1. Katmai National Park and Preserve (KATM) managed by the KATM office in King Salmon
2. Alagnak Wild River (ALAG) managed by the KATM office
3. Aniakchak National Monument and Preserve (ANIA) managed by the KATM office
4. Lake Clark National Park and Preserve (LACL) managed by offices in Port Alsworth, Anchorage and Homer

These park units fall within the Southwest Alaska Network (SWAN) of the NPS Inventory and Monitoring (I&M) Program (Appendix A). The SWAN recently identified brown bears as an essential vital sign to monitor within the I&M program. This protocol narrative along with 7 SOPs explains the processes for successful execution of the brown bear monitoring program in SWAN park units.

The NPS initiated the creation of "vital signs monitoring" to address the need to observe and understand the condition of park natural resources. A vital sign is defined as "a set of physical, chemical, and biological elements and processes of park ecosystems that are

selected to represent the overall health or condition of park resources, known or hypothesized effects of stressors, and/or are of value to humans" (Bennett et al. 2006). Vital signs monitoring develops scientifically sound information on the status and long-term trends of park ecosystems and determines how well current management practices are sustaining those ecosystems (Bennett et al. 2006).

The ecosystems within the SWAN parks are unique because they have intact populations of wilderness-dependent large mammal species, naturally functioning terrestrial ecosystems, and historic levels of biodiversity (Bennett et al. 2006). These characteristics of land systems for large carnivores are increasingly rare worldwide. This is particularly true for brown bears. The SWAN parks support intact brown bear populations, seen uncommonly in the world today, where bear numbers and ranges south of Canada have declined by over 95% (ADF&G 2000) and global populations are a fraction of their historic range (Schoen 1989).

Brown bears were ranked as "essential" during the NPS vital signs selection process. This was due to their potential in possessing: a high importance in controlling ecosystem function, usefulness as an indicator, strong linkages to other attributes in network ecosystem models and high relevance to park resource management and protection. This ecological and management significance to the SWAN clearly defined the necessity to create a long-term brown bear monitoring strategy for KATM, LACL, ALAG and ANIA. Brown bears were not selected as a vital sign in Kenai Fjords National Park, the fifth park unit within SWAN (Appendix A), because historic and current populations are too few to warrant monitoring.

Monitoring of brown bears in the four park units of the SWAN is dependent upon appropriate development and testing of monitoring protocols. This includes a well designed and implemented sampling strategy including successful execution of pre-season logistics, preparation of survey transect routes for sampling, completion of aerial surveys for bear count data and quality data management, analysis and reporting. The primary tool that will be used to accomplish the monitoring protocol for brown bears in SWAN parks is aerial surveys conducted from fixed wing aircraft. Data on abundance and distribution of brown bears will be obtained from these aerial surveys at 5 to 10 year intervals and analyzed for long-term trends.

1.2 *Rationale for monitoring brown bears*

Brown bears are a fundamental component of ALAG, ANIA, KATM, and LACL parks and are listed in the enabling legislation of ANIA, KATM, and LACL. They are an important species to monitor because they play a key ecological role in their environment (Reimchen 2000). They are integral in ecosystem nutrient cycling (Tardiff and Stanford 1998, Robbins et al. 2004) and serve as a means of nutrient transfer from spawning salmon (*Oncorhynchus* sp.) (Gende et al. 2002) and marine nitrogen (Hilderbrand et al. 1999a) to the terrestrial system. They play important ecological roles as top predators by influencing population dynamics of ecosystem community species. This has been documented between brown bears and moose (*Alces alces*) (Ballard and Miller 1990),

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moose calves (Ballard et al. 1981), caribou (*Rangifer tarandus*) (Boertje et al. 1988), other bears (Hessing and Aumiller 1994, Sellers et al. 1998, Ben-David et al. 2004), and salmon (Quinn and Kinnison 1999, Ruggerone et al. 2000, Gende et al. 2004). Furthermore, they are important indicator species for other valuable wide-ranging mammals such as wolves (*Canis lupus*), wolverine (*Gulo gulo*) and lynx (*Lynx canadensis*) (Matz 2000).

From a park management perspective, brown bears are integral vital signs to monitor. Bears are important culturally and recreationally to people in Alaska (Matz 2000). Surveys by the Alaska Department of Fish and Game (ADF&G) have indicated that brown bears are Alaska's most valuable species of wildlife from the perspective of both wildlife viewers and hunters (Matz 2000). They support the livelihood of businesses and have become economic drivers in some communities. Further, they provide valuable resources for subsistence users and are culturally valuable to Native Alaskans (Mogart et al. 1992, Van Daele et al. 1998).

High densities of brown bears exist in ALAG, ANIA, KATM, and LACL. KATM has the highest documented density of brown bears in North America (Sellers et al. 1999). Coastal environments rich in food resources such as marine mammals, clams (*Siliqua* sp., *Protothaca staminea*, *Saxidomus gigantus*), sedges (*Carex* sp.), terrestrial prey species, and salmon support these high bear numbers. The latter are of particular importance and have been shown to influence a variety of demographic and life history parameters of brown bears (Hilderbrand 1999b, 1999c, 2004).

These productive coastal regions also attract sportfishers, bear hunters, subsistence users, bear viewers and backcountry recreationalists. Understanding potential pressures from human activities on bear populations is important for management of their long-term viability (Mattson 1989). Human activities are increasing in SWAN parks. Bear viewing has increased in the past two decades (National Park Service 2004) and the demand for bear viewing along west Cook Inlet (including SWAN park units) has exponentially increased in recent years (Matz 2000). Effects of human activities on bears have been documented including sportfishing (Smith 2002), bear viewing (Olson et al. 1997, Rode et al. 2006a-c) and habituation (Smith et al. 2005). Bear hunting and bear take (numbers of bears killed) have also been increasing (Matz 2000). Interest from the Alaska Board of Game in opening more bear hunting areas on state and federal lands adjacent to SWAN parks adds further potential pressures on area bears (Titus et al. 1994). Brown bears are a long-lived species with low recruitment potential and are prone to inadvertent overharvest (Becker 2003). All of these human activities create potential pressures on bears in SWAN parks and understanding more about brown bear populations through monitoring will help facilitate park management efforts.

Long-term monitoring data on brown bears in ALAG, ANIA, KATM, and LACL park units have been lacking in the past and therefore, potential impacts to brown bears from a diverse array of human users are largely unknown. These unknowns, combined with the vital ecological roles brown bears play, creates a pressing need to gain a further understanding of bear distribution and abundance in SWAN park units.

1.3 *Measurable objectives*

Monitoring of brown bears in ALAG, ANIA, KATM and LACL is designed to answer the following question: are numbers and distribution of brown bears remaining stable in these parks?

The specific measurable objective is:

- Estimate long-term trends in abundance and area of occupancy of brown bears from a random sample of relevant elevations and terrains in ALAG, ANIA, KATM, and LACL.

II. Sampling Design

2.1 *Current Design and rationale for selecting this design*

The current sampling design that will address the monitoring objective of estimating long-term trends in brown bear abundance and area of occupancy in SWAN parks includes 3 design components: a membership (stratified random), response (aerial survey, double-count line transect with covariates) and revisit (every 5-10 years). This particular design was selected because of cost, accessibility, and maximum allowable bias and variance (Bennett et al. 2006).

The membership component of the sampling design, stratified random, will dictate spatial allocation of sampling effort. Stratified random sampling will be used to select areas to perform aerial surveys of brown bears and stratification criteria will include physical features related to perceived densities of bears. For example, extreme high elevation areas within SWAN will be excluded from sampling due to lack of bear occupancy. Sampling unit areas (study areas) will typically be delineated as park unit boundaries or ADF&G Game Management Units that overlap with park unit boundaries. Line-transects will be determined within these study areas using a randomization process detailed in below sections and in SOP 1.

Stratified random sampling was selected because the randomized procedure used to select units allows a known probability of selection and results can be statistically inferred to the larger sampled population (Bennett et al. 2006). For example, abundance estimates derived from line-transects and areas surveyed via fixed wing aircraft can be extrapolated on a park-wide spatial scale because of the random selection process. Non-randomly selected transects would only provide valid abundance estimates within the actual area surveyed.

The response design component that addresses this objective is aerial survey sampling of contour line-transects using double-count and covariate data (Quang and Becker 1996, 1997, 1999) and is a variation of standard distance-sampling theory (Buckland et al. 2001, 2004). The development of this specific aerial survey sampling method has been a

collaborative effort between ADF&G Biometrician Earl Becker and the University of Alaska Fairbanks, Department of Mathematics Professor Dr. Pham Quang. This sampling design is a result of about 10 years of refining various line-transect models (Quang and Becker 1996, 1997, 1999) which were originally based off of brown bear data collected on Kodiak Island (Barnes and Smith 1995, Becker 2003, Barnes, USFWS, pers. comm.). ADF&G and NPS staff have collaborated further to refine methodology through field testing this survey approach in KATM and LACL.

The approach uses a combination of double-count data, perpendicular distances from fixed wing aircraft to detected bears, and other relevant variables to provide a park-wide estimate of bear abundance and distribution. Two independent observers in the aircraft record locations of detected bears and other key variables or covariates (double-count data; Table 2-1) along randomly selected line-transects that follow elevational contours in mountainous terrain. Double-count data are necessary to relax the key assumption of line-transect sampling that all objects (e.g., bears) are sighted along the transect line (Buckland et al. 2001). Perpendicular distances are calculated from GPS location points recorded during surveys. These include a) the bear location as determined by flying over the bear and b) the point along the transect that yields the shortest straight line perpendicular distance between the flown transect and recorded bear location. Another key variable in modeling is the effective distance, also referred to as search distance or horizon location. This covariate is an estimate of horizon openness and is recorded for every bear (or groups) detected. This distance reflects the ease or difficulty of sighting a bear (Quang 2005). Further details on data collection are discussed in SOP 3.

Table 2-1. Covariate data collected during aerial surveys of brown bears in SWAN parks.

Covariate Data	Justification for Collecting
Bear species detected (brown or black)	Population estimate
Bear group size	Population estimate
Bear group type (sex and age)	Population estimate
Bear Activity at time of detection	Can contribute to sightability
Percent vegetation cover	Helps estimate sightability
Snow cover at detection point	Helps estimate sightability
Who (pilot, observer or both) detected the bear	Provides double-count data that contributes to sightability factor to provide a valid population estimator
Perpendicular distance to bear detected	Contributes to sightability factor to provide a valid population estimator
Effective distance (aka search distance)	Key modeling variable, sightability

Survey routes (contour line-transects) are established prior to field data collection and outlined on maps for field use. These routes are randomly selected using the program ADF&G Bear Random Transects (AdfgBearTrans) developed by Becky Strauch of the ADF&G (Becker 2001, Strauch, ADF&G, pers. comm.). All transects have equal lengths to avoid biases that may occur if bears' prefer certain elevation ranges. Survey routes are flown at 100 meters Above Ground Level (300 feet AGL) along transects consisting of a variety of elevations and terrains. Surveys occur in May after bears have emerged from

winter dens and prior to vegetation leaf out. Selection of survey routes are discussed in more detail in SOP 1 and aerial survey procedures are discussed in SOP 3.

Independence between observers is an important assumption of this population estimator and is addressed through the use of a curtain-and-light system. A curtain is positioned between the pilot and rear seat passenger inside the aircraft. The curtain partitions the aircraft in half so that pilot movement does not alert the rear seat passenger to potential bear sightings.

A light system is used to signal the sighting of a bear. The light is concealed but available for both observers to view. When an observer sees a bear or group of bears, he/she turns on the concealed light. Once the plane has traveled past the bear, 5 seconds beyond the front wing strut of the aircraft, the observer who sighted the bear prepares to announce his/her sighting. First, he/she examines the other observer's light to see if it is illuminated. If it is, both observers have seen the bear. If it is not, only one observer has detected the bear. The 5-second time delay in announcing the sighting ensures both observers have ample time to detect the bear without compromising independence of observations.

A line-transect model is fitted to each observers' data using a partial likelihood model, the double-count data are used to estimate the probability of detection at each apex and a Horvitz-Thompson estimator is used to incorporate the bears' probability of detection into the abundance estimate (Becker, ADF&G, pers.comm.). The covariate data are used in conjunction with the perpendicular distance data (bear location and effective distance) to create detection functions to estimate the probability of detection. The Horvitz-Thompson estimator incorporates the estimated detection probability into an abundance estimate for brown bears. See SOP 4 for additional information on estimating abundance and area of occupancy of brown bears in SWAN parks.

Rationale for selecting this particular response design includes cost, efficiency and applicability. The vast size and terrain of SWAN parks precludes ground survey methods for brown bears and aerial surveys conducted from fixed wing aircraft are the next logical option because they are often the quickest and most cost-effective way to determine and monitor the status of wildlife populations (Becker 2001). Previous attempts to estimate bear population size in Alaska involved expensive and intensive mark-recapture techniques (Miller et al. 1997, Becker 2003). This method employing aerial surveys using line-transect methods is more cost effective and less intensive.

Aerial surveys using line-transect methods have been employed in the wildlife profession for many years (Drummer et al. 1990, Johnson et al. 1991, Quang and Lanctot 1991) but until recently realistic models that gave valid population estimates of brown bears in Alaska were lacking. Estimating sightability of brown bears and surveying in mountainous terrain provides challenges. For example, aerial line-transect sampling is limited to flat terrain because flying linear transects in uneven terrain causes the plane's height above ground to constantly shift. This shift causes changes in sightability and eliminates the possibility of using strut marks to record sightings into distance classes

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(Becker 2001). Methods to incorporate differences in animal sightability have been developed for sightability models (Steinhorst and Samuel 1989) and line-transect models (Quang and Becker 1996). Quang and Becker (1999) developed the improved approach employed here that makes adjustments to detection probabilities through the use of perpendicular distances, double-count and covariate data. More recent procedures use the effective distance covariate for further refinements to this process (Becker, ADF&G, pers.comm.). These data are used in this sampling design to provide a valid population estimator of brown bears in mountainous terrain (Quang and Becker 1999, Becker 2001).

The revisit design component of the sampling design, or sampling frequency, for brown bear monitoring is 5-10 years. Transects will be selected once, surveyed, and then re-sampled according to this timeframe which is dictated by logistical/funding constraints and the level of temporal variation in brown bear populations. The revisit design was selected for its ability to retain a representative sample across time. It is based on the ideas that the stratified random membership design will capture population shifts or large shifts are not expected to occur (Bennett et al. 2006).

The sampling design used here will be reviewed every 5-10 years (Bennett et al. 2006). Any changes to the design will go through a review process described in SOP 7.

2.2 *Recommended number/location of sampling sites and frequency/timing of sampling*

Flights are flown daily, weather dependent, for 10-14 days or until the number of pre-determined transects (sampling sites) have been flown. Bears typically emerge from hibernation dens in April and by May are available for detection. Vegetation leaf out generally occurs in late May or early June. Therefore, timing of sampling occurs in May after bears have emerged from dens but prior to leaf out because the probability of detecting bears is highest at this time.

Transects are selected randomly using the AdfgBearTrans program. The number of transects should be sufficient to ensure ample bears are counted in order to obtain valid population abundance estimates. Based on previous surveys within Alaska, a minimum of 175 bear groups must be observed to derive a statistically valid estimate (Becker, ADF&G, pers. comm.). Depending on bear densities and park resources (staffing and availability of pilots), one survey will take 1-2 spring sessions to complete. Preliminary surveys of LACL and KATM took 10 days each in May of 2004 and 2005 to derive a population estimate. Likewise, a recent brown bear survey using this sampling procedure was conducted in Togiak National Wildlife Refuge. The sampling window used to yield one population estimate included a 10-15 day period in May of 2003 and 2004 (Collins, USFWS, pers. comm.).

2.3 *Level of change that can be detected for the amount/type of sampling being instituted*

The level of change detected by the sampling being instituted for this protocol will be related to the frequency of aerial surveys conducted over time and the precision of individual estimates. More precise individual estimates will detect smaller changes in

population size. Due to the vast size of the park units and budget constraints it will not be possible to conduct surveys annually. Brown bear populations usually will change slowly enough that surveys conducted in 5-10 year intervals will be sufficient for the purposes of this monitoring protocol.

Further details on the sampling design used to monitor brown bears in ALAG, ANIA, KATM and LACL are provided in SOP 3.

III. Field Season

3.1 *Field season preparations and equipment setup*

Aerial surveys will be conducted in May. Personnel will be trained, field computers will be checked for proper working order and data forms, survey routes and maps will be prepared. For estimated timelines refer to Table 6-1, for details on field season preparation see SOP 1, (Preparations for the Field Season), and SOP 2, (Training Observers).

3.2 *Sequence of events during field season*

The sequence of events during the field season are as follows. More detailed information is included in SOPs 1-3.

- Gather field equipment at the office prior to meeting survey aircraft. Equipment to bring includes personal gear (e.g., survival gear, NOMAX suit, helmet, safety equipment, lunch, extra clothes, water) and survey gear (e.g., on board laptop computer, GPS, notebook, pencils, curtain, light system).
- Meet the pilot and prepare aircraft for survey. Connect the GPS to the laptop via the data cord and ensure the GPS is inputting data into the laptop. Load up and take off.
- Data Collection- collect data as detailed in the next section 3.3 and SOP 3.
- Upon landing after flight completion, gather all gear from the plane and report back to office. File gear.
- Perform data verification, download laptop, copy data forms, make back-ups, and record necessary information relevant to the flight.

3.3 *Details of taking measurements, with example field forms*

A high level of detail will be devoted to accurately recording field measurements. Two primary tools are used to achieve minimal data errors when collecting brown bear monitoring data: properly training observers (SOP 2) and using field computers in conjunction with formatted project specific data forms. All data forms should be legible, complete, and printed on acid free paper to prevent fading over time. Refer to the data management plan (Southwest Alaska Network 2006) if changes to data fields become necessary. Refer to SOP 3 for details on conducting aerial surveys and data recording procedures.

3.4 *Post-collection processing of information*

- Download all data from the laptop computer, GPS unit and digital camera (if used). Complete data verification and validation checks as described in SOP 5 and the Southwest Alaska Network (2006). Back-up data and store at an offsite location. Charge electronics as needed.
- Check all original data forms for legibility and completeness. Complete data verification and validation checks on data. Any changes to data forms should be crossed out with a line and the new information written below. No errors should be erased or completely crossed out. Make photocopies of the originals. Copies should be archived in a safe location off site upon survey completion.
- Enter raw data into the computer as soon as possible after returning from the field.
- Stow gear and equipment in appropriate locations.

3.5 *End-of-season procedures*

End of field season procedures include performing final organization of data, equipment, budgeting information and preparing data for summaries and analysis. All data forms and data file back-ups should be filed in an organized fashion at park headquarters office as well as an off site location. Long-term archiving of data will be performed at the Alaska Regional Curation Center (ARCC) located at the NPS Alaska Regional Office in Anchorage (see SOP 5). Ensure all hours from aerial surveys are logged and personnel time and effort are recorded for budgeting purposes. Clean, organize and store survey equipment in appropriate locations.

IV. Data Handling, Analysis and Reporting

An overview of data handling, analysis and reporting are described in Figure 4-1. Data handling involves collecting data via aerial surveys and processing the information into a usable format for analysis. Once data are prepared, analyses are conducted (see SOP 4 on data analysis) and results are interpreted. Findings are then presented in writing via reports (see SOP 6 on Reporting).
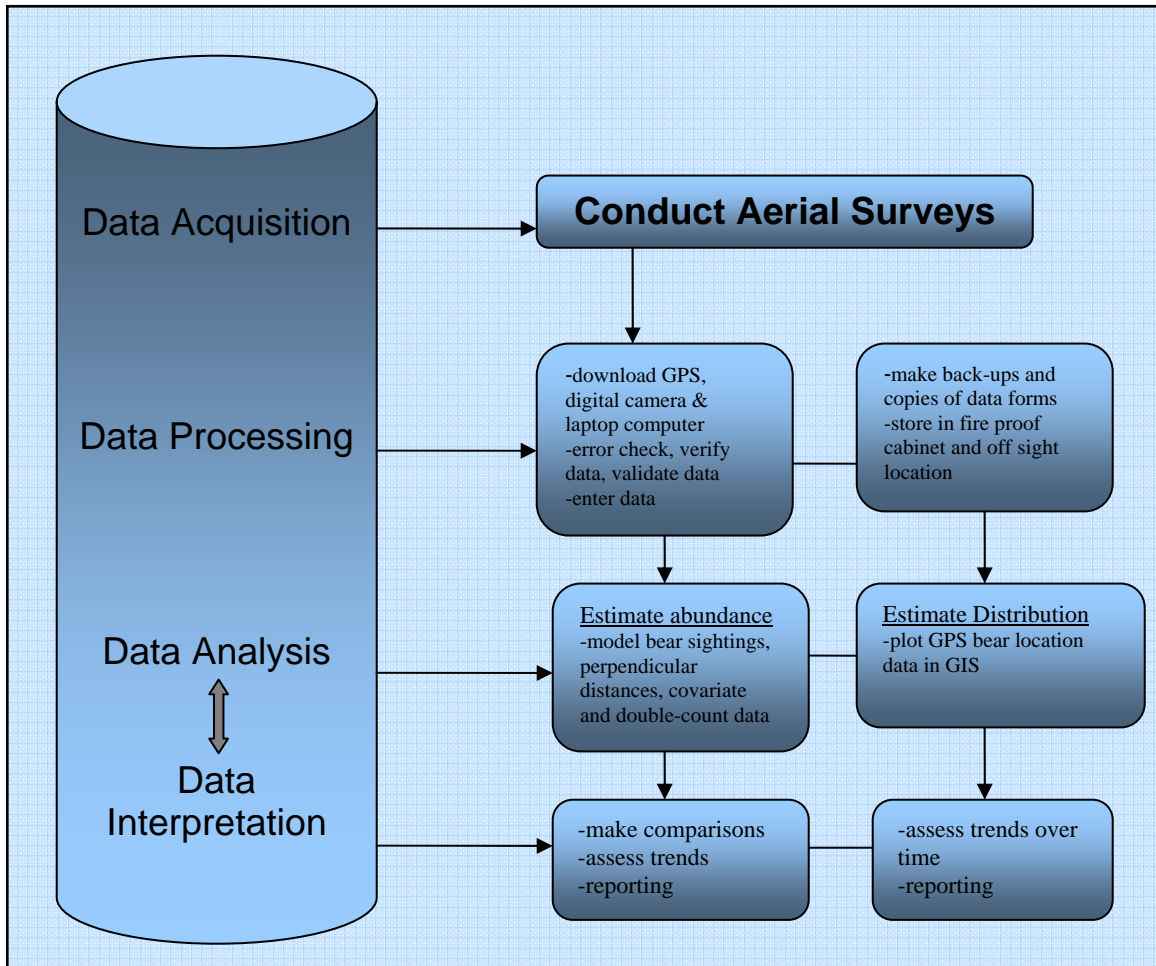
Figure 4-1. Flow chart of data handling, analysis and reporting for brown bear monitoring (adapted from Reed et al. 2005).

4.1 *Metadata procedures*

Refer to SOP 4, Data Management.

4.2 *Overview of database design*

Refer to SOP 4, Data Management.

4.3 *Data entry, verification and editing*

Data will be entered as soon as possible upon returning from the field. This will help to ensure minimal error in the data management process. When data are entered soon after being collected, errors are more easily detected and corrected. Data will be first verified and then validated to ensure minimum error. If edits to data are needed, information will be crossed out on data forms with one line and the corrected information will be written below. Erroneous information will not be crossed out completely per directives outlined

in the Southwest Alaska Network (2006). This plan recommends two people enter data. One person will read the information off the data forms while the second will type data into the computer. If only one data entry staff member is available, they will enter data slowly to minimize entry errors.

GPS data of brown bear locations will be plotted into a map program as soon as possible. Location data will be verified for accuracy in relation to survey area boundaries and transect routes.

4.4 *Recommendations for routine data summaries and statistical analyses to detect change*

- Summary of data on abundance and distribution every 5-10 years
- Trend analysis-estimate after 10 years of data and every 10 years thereafter
- Spatial analysis-maps will be generated on bear location data and distribution
- Statistical analysis-modeling procedures will be conducted to derive abundance estimates and summary statistics

These are described in more detail in SOP 4 on Data analysis.

4.5 *Recommended report format with examples of summary tables and figures*

Reporting is the culmination of the brown bear monitoring effort. The main objective of brown bear monitoring efforts in SWAN parks is to determine abundance and distribution within study areas. Therefore, summaries of bear abundance and distribution data will be included in monitoring reports. Reports will conform to specific guidelines outlined by the SWAN. Reports will include maps, graphs, figures and other visuals to facilitate comprehension of findings. Example summary tables are below (Table 4-1).

Table 4-1. An example summary table for brown bears observed during aerial survey efforts (Collins, USFWS, pers. comm.).

Date	# of transects	# of bear groups	# of individual bears	Groups/transect
5/19/2004	35	6	9	0.26
5/20/2004	46	11	15	0.33
5/21/2004	49	12	18	0.37
5/22/2004	55	18	22	0.40
5/23/2004	53	14	16	0.30
5/25/2004	21	5	6	0.29
5/26/2004	60	20	26	0.43
5/27/2004	52	19	23	0.44
5/28/2004	36	8	11	0.31

Other summary data may include sex and age class of observed bear groups during annual survey efforts and/or percent cover recorded around bear groups (Table 4-2).

Table 4-2. Example summary table for bears observed by percent cover for brown bear monitoring data (Collins, USFWS, pers. comm.).

Percent Cover	Number of bear groups	Number of individual bears	Percent bears observed in cover type
0	41	67	35
10	20	34	18
20	11	18	10
30	9	16	8
40	8	9	5
50	7	10	5
60	8	10	5
70	5	8	4
80	6	7	4
90	3	6	3
100	2	4	2

Example figures may include maps detailing bear locations and distribution across the landscape, areas surveyed, cover types observed and sex/age groups observed throughout time. Additional information relevant to reporting is discussed in SOP 6.

4.6 *Recommended methods for long-term trend analysis*

Please refer to SOP 4.

4.7 *Data archival procedures*

Long-term archiving of brown bear data will occur at the ARCC. The data files and for brown bear monitoring efforts will be stored on the SWAN server. All hard copy materials, such as log books, copies of data forms and other resource materials are considered "mission critical" and will be stored in the long-term archive at the ARCC. Hard copy materials may also be stored at the associated park headquarters facility, such as the KATM or LACL offices. In this case, copies of all materials will be made and sent to the SWAN archive. See SOP 5 on Data Management for detailed information related to archiving data.

4.8 *Reporting*

Reports generated by brown bear monitoring efforts will be designed to be promptly produced, appropriate to their target audience, widely available, and readily accessible. Concise summaries will be a part of each report produced. Reports will conform to SWAN guidelines and will include maps, graphs, figures and other visuals to facilitate comprehension of findings. See SOP 6 on Reporting for more details.

V. Personnel Requirements and Training

5.1 *Roles and responsibilities*

The implementation of this protocol requires advanced knowledge of GIS, database applications, survey operations, data management and statistical methodologies (Table 5.1). Pilots experienced in wildlife survey operations will be required and ideally seasoned observers will be needed as well. Experience of observers can vary. Seasoned observers that are experienced in spotting wildlife and comfortable in small aircraft typically detect more bears and wildlife verses new observers. However, if experienced observers are not available, new observers will go through a training to prepare them for survey operations (SOP 2). A high level of expertise by a biometrician will be required throughout the duration of the protocol to conduct the statistical modeling portion of data analysis and to interpret findings. Modeling procedures are still in refinement at this time.

Table 5-1. Work flow and responsibilities for monitoring brown bears.

Task	Personnel
Data Acquisition: -Aerial surveys	Project Leader/Wildlife Biologist GIS Specialist Other Park Wildlife Biologists Park Pilots/Contracted Pilots Other Observers
Data Management: -Copy new files to Central Data Server -Manage data formats, directory structure, archiving -Maintain consistent data characteristics and software compatibility with other SWAN data sets	Project Leader/Wildlife Biologist GIS Specialist Data Manager Network Coordinator SWAN Project Leader Crew Member/ Biological Technician
Data Analysis and Interpretation: -Manual interpretation of field data -Spatial analyses -Trend analyses -Data summaries	Biometrician Wildlife Biologist SWAN Project Leader
Reporting	Biometrician Project Leader/Wildlife Biologist SWAN Project Leader
Back-ups	All Users (local) and SWAN data manager (archives)
Minor Protocol Revisions and Documentation	Project Leader/Wildlife Biologist, Network Coordinator, SWAN Project Leader
Major Protocol Revisions	Work group-designated

5.2 *Qualifications*

A project leader/wildlife biologist, biometrician, GIS specialist and data manager are key

personnel required to develop and complete the process of monitoring brown bears in SWAN park units. The project leader/wildlife biologist executes pre-season logistics, conducts aerial surveys to obtain bear count data, and performs data management and reporting. In previous surveys, this individual was a park wildlife biologist. The SWAN project leader may or may not be the same individual as the project leader/wildlife biologist. If the same individual is not in this position, they will be responsible for overall project supervision of the SWAN terrestrial vital signs monitoring program. The biometrician is instrumental in sampling design development and testing as well as the development of analysis procedures for abundance and distribution estimates. Once sampling design procedure development is complete, the biometricians' effort towards monitoring will be less but still on-going due to the complexities of the modeling involved. Future changes or refinements to the sampling design or monitoring analysis will be performed by the biometrician and designated review group. The data manager will conduct the long term archival processes related to storing brown bear monitoring data on the SWAN server. Table 5-2 outlines qualifications for personnel necessary to complete bear monitoring efforts.

Table 5-2. Personnel qualifications for executing the protocol for monitoring brown bears in SWAN park units.

Personnel	Qualifications/Experience
Wildlife Biologist/Project Leader	• Experience or ability to conduct aerial surveys and fly in small aircraft for long periods of time • Ability to synthesize information from multiple data sets to develop summary reports • Experience with wildlife statistical procedures • GIS expertise
Biometrician/Statistician	• Extensive experience in all aspects of sampling designs and data analysis associated with monitoring and research, development and application of models • Familiarity with model development, biometrics and statistical procedures related to wildlife populations • Ability to develop methods for data analysis and refinements related to bear monitoring
Data Manager	• Extensive experience with all aspects of data management • Ability to work with principal investigators to design appropriate databases for data collection and integration of data

5.3 *Training procedures*

Please refer to SOP 2 for training procedures.

VI. Operational Requirements

6.1 *Annual Workload and Field Schedule*

Pre-season preparations will occur prior to the May survey timeframe, typically between January and April. Survey flights will occur in May but the exact timeframe will depend on spring bear emergence from dens and leaf out. Task and workload estimates are in Table 6-1.

Table 6-1. Estimated workload and schedule for monitoring brown bears in SWAN park units.

Task	Timeframe	Workload
Pre-season tasks -obtaining permits -readying equipment -determining survey routes -printing maps -training observers	January-April	• 5 hours • 100 hours • 80 hours • 10 hours • < 1 week
Conducting aerial surveys	May	• 200 hours of flight time, 10-14 days
Downloading survey data and quality assurance	May	• 40 hours
Post-season wrap up	June	• 80 hours
Analyzing survey data	Oct-Jan	• 100 hours
Data management	On going	• 100 hours
Reporting	Dec-Feb	• 60 hours

Downloading data will occur in the evening after survey flights are conducted. Data analysis and reporting will occur during the fall and winter months following surveys. Data management will occur throughout the year as needed and as detailed in SOP 5.

6.2 *Facility and Equipment Needs*

Equipment requirements to successfully conduct brown bear monitoring include aircraft for survey flights, sufficient staff to observe and assist in field procedures, laptop computers and GPS units for electronic data recording during flights, home base computers (for data management, pre-season transect selection and mapping, and data analysis) and a printer and plotter. Up to 5 aircraft may be needed to complete aerial surveys. The number of GPS units and field laptop computers required will coincide with the number of aircraft the project leader deems necessary to complete survey transect allotments in the specified timeframe. At least one spare laptop computer should be available for survey use in case technical issues arise with primary equipment.

Facility needs include an area to base the computer and printer and storage of equipment, data and data back-ups. Fuel caches may be required. See SOP 1 for detailed information on facility and equipment needs.

6.3 *Start up costs and budget considerations*

Start up costs for the preliminary surveys conducted in KATM and LACL in 2004-2005
are included in Table 6.2 below. Based on this information, the bulk of the budget for
future surveys will be associated with aircraft operation and salaries. Expenses for ANIA
will probably be more than other park units in the SWAN because of its extremely
remote nature. More fuel will be needed for surveys and the time necessary to complete
surveys will also be increased due to longer flying times to reach survey locations.
Longer flying times will increase the overall survey effort impacting staff time and
associated salary cost increases. Salary estimates (see table below) are based off a team
of 5 observers who will typically be park biologists and technicians. Some overtime will
be required due to the long nature of survey days.

Start up equipment costs include light systems, curtains, GPS units, antennas, interface
cables, port adapters, power converters, and light adapters needed for aerial surveys.

Food and housing will be needed for the pilots and staff survey team (8-10 people) for a
period of 10-14 days in May. Housing will most likely be provided by the host park,
KATM or LACL, depending on survey locations.

Table 6-2. Estimated costs for monitoring brown bears for two park units in the SWAN.

Estimated Costs	KATM	LACL
Food ($35/day for 14 days, 10 people)	4,200	4,200
Contract Aircraft (2) for 10 days (100 hrs @ 165/hr)	16,500	16,500
DOI agency Aircraft (2) for 10 days (100 hrs @ 90/hr)	9,000	9,000
Fuel 1600 gallons @ $4.00/gal	6,400	6,400
Start Up Equipment Costs	2,000	500
Salaries including overtime	14,000	14,000
Total	52,100	50,600

VII. Procedures for Revising Protocol

The protocol narrative and each SOP contain a revision history log that will be filled out
when they are revised. The new version of the SOP and/or protocol narrative will then be
archived in the SWAN protocol library under the appropriate folder. The procedures for
changing the protocol (either the protocol narrative or the SOPs) are outlined in SOP 7.

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Appendices

Appendix A. The Southwest Alaska Network National Park Units (Bennett et al. 2006). (Note that brown bear monitoring occurs in all units *except* Kenai Fjords National Park)